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Paleogeographic Implications of Late Paleocene *Onestia onestae* (Bivalvia: Cardiidae) in Arctic Alaska

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Introduction

The northernmost and youngest occurrence of the cardiid bivalve *Onestia onestae* (McLearn, 1931) is reported from Upper Paleocene beds (Marincovich, 1996; Bice et al., 1996) in the Prince Creek Formation near Ocean Point, northern Alaska (70°04′N, 151°22′W). The only previous occurrences of *O. onestae* are in middle Cretaceous strata of central Alberta, Canada: the upper Aptian Clearwater Shale (McLearn, 1933) (approx. 57°N, 112°W) and the lower Albian lower sandstone member of the Peace River Formation (McLearn, 1931) (approx. 56°N, 117°W). This is the only occurrence of *Onestia* in the northern hemisphere. Three other species of *Onestia* occur in Aptian and Albian faunas of Australia (Day, 1978).

Systematic Paleontology

Family Cardiidae Lamarck, 1809

Subfamily Lahilliinae Finlay & Marwick, 1937

Genus *Onestia* McLearn, 1933

Onestia onestae (McLearn, 1931)

(Figures 1–7)

Laevicardium onestae McLearn, 1931:7, pl. 1, fig. 1.
Integricardium (*Onestia*) *onestae* (McLearn) McLearn, 1933:152–153, pl. 2, figs. 8–10.
Onestia onestae (McLearn) McLearn, 1945:10, pl. 3, fig. 9; Jeletzky, 1964:9, 76, pl. 24, figs. 9, 11; Day, 1978:38, pl. 1, figs. 1–3.

Table 1

Dimensions of complete valves of *Onestia onestae*. See Schneider (1995, in press) for explanations of height, length, and anterior length.

	Dimensions (mm)			
	Height	Length	Anterior length	Inflation
GSC 6345	24.7	31.6	10.1	9.1
GSC 8004	26.0	31.0	13.0	10.0
USGS [M9158] (right valve)	16.4	18.9	7.7	5.3
USGS [M8120] (left valve)	26.2	31.9	12.5	9.3
USGS [M8120] (right valve)	27.6	30.7	14.4	9.4

Description: Elliptical in shape, moderately inflated, umbones located slightly anteriorly (see Table 1 for measurements). Anterior and ventral margins convex, posterior margin less convex and slightly oblique. Sculpture consists of growth lines only. Beaks low, slightly prosogyrous. Ligament groove short. Pallial sinus absent. Adductor muscles subcircular, faintly impressed. Hinge teeth arranged as in *Protocardia* and *Integricardium* (see Schneider, 1995), but anterior cardinals more robust. Right anterior cardinal thick and blunt, right posterior cardinal strong, subconical, and pointed. Right anterior cardinal socket deep and conical. Right posterior cardinal socket shallower and usually broader. Right anterior lateral tooth weak; overlying anterior lateral socket shallow. Right posterior lateral long, narrow, but not bladelike. Overlying posterior lateral socket moderately deep. No known specimens of left valves are well-preserved enough to describe hinge in detail.

Material: Holotype, Geological Survey of Canada-GSC 6345, left valve (Figure 1), lower Albian Peace River Formation, Alberta; plesiotypes GSC 8003 (left valve) and 8004 (right valve, Figure 2), upper Aptian Clearwater Shale, Alberta; University of California Museum of Paleontology, Berkeley, California. UCMP 154061 (right valve, Figures 3 and 6) and UCMP 154062 (left valve, Figures 4, 5), United States Geological Survey, USGS locality M8120, Ocean Point, Alaska; UCMP 154063 (Figure 7) and 154064 (two right valves), USGS locality M9158, Ocean Point, Alaska; UCMP 154065, 154066, and 154067 (three right valves), USGS locality M8120; all UCMP specimens from Upper Paleocene Ocean Point beds of Prince Creek Formation.

Discussion

There is a stratigraphic gap of some 45 to 50 million years (Harland et al., 1990) between the Canadian and Alaskan occurrences of *O. onestae*, but the Paleocene

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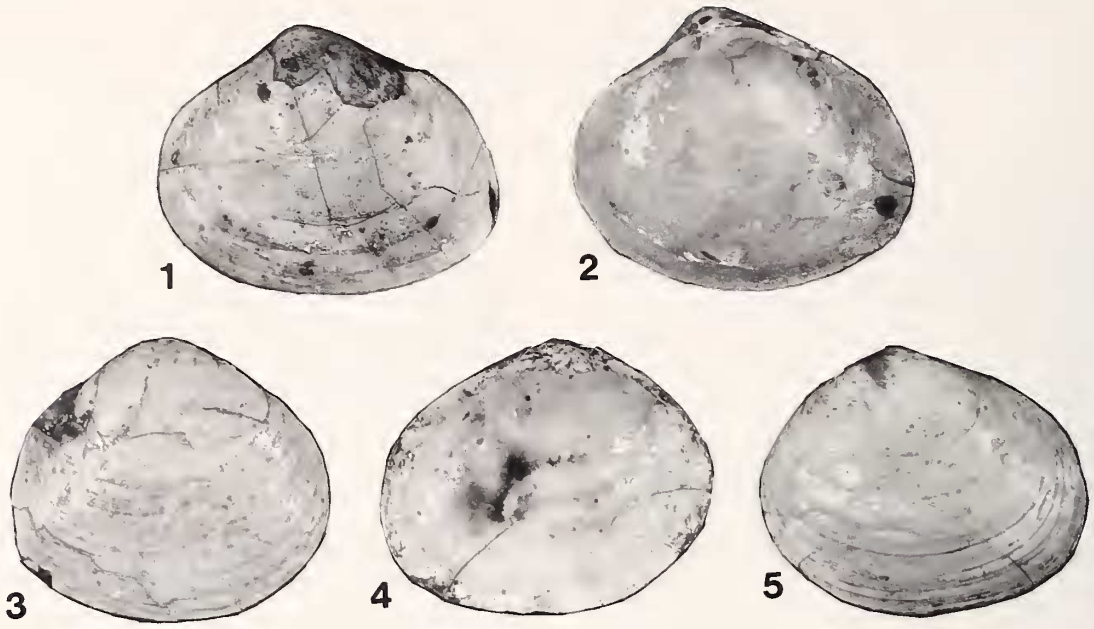


Explanation of Figures 1 to 5

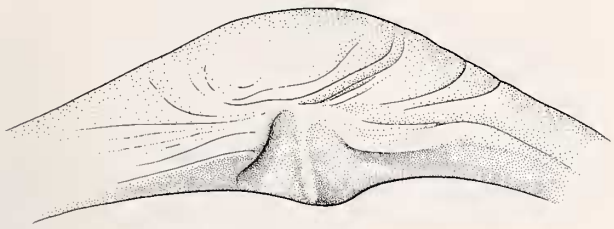
Figure 1. *Onestia onestae,* external view of left valve, ×1.35, GSC 6345. Figure 2. *Onestia onestae,* internal view of right valve, ×1.35, GSC 8004. Figure 3. *Onestia onestae,* external view of right valve, ×1.35, UCMP 154061. Figure 4. *Onestia onestae,* internal view of left valve, ×1.35, UCMP 154062. Figure 5. *Onestia onestae,* external view of left valve, ×1.35, UCMP 154062.

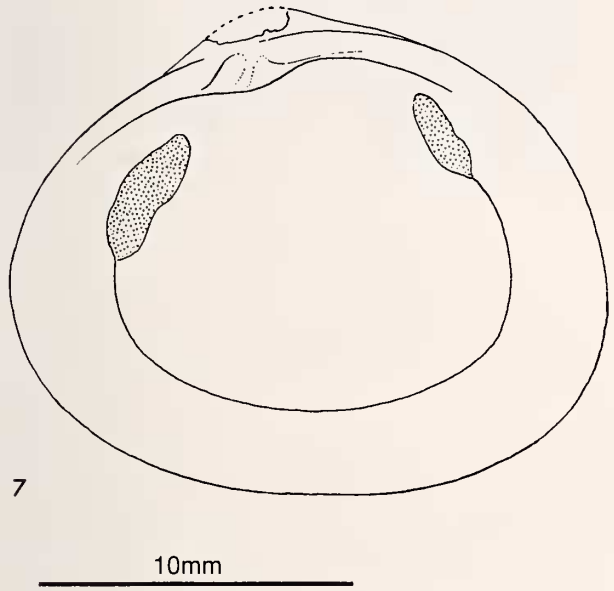
specimens are so similar to the Cretaceous specimens that erection of a new species for the former is unwarranted. The similarity between the Aptian-Albian and Paleocene specimens may partly result from *Onestia* having lost or reduced the characters that are normally used to discern cardiid species: the external ornamentation of most cardiids is lost, and the lateral teeth are reduced. Shell shape is most commonly used to discriminate between species of Cardiidae which have undergone such losses and reduction, such as within *Onestia*'s fellow lahilliines *Lahillia* (Cossmann, 1899) and *Integricardium* (Rollier, 1912); and the Canadian and Alaskan forms of *Onestia* cannot be discriminated on the basis of shell shape (Table 1). The Paleocene forms are therefore classified as *Onestia onestae.*

Marincovich (1993) reported two additional cardiids from the Ocean Point beds: *Integricardium* (*Integricardium*) *keenae* Marincovich, 1993, and *Protocardia*? sp. indet. One other species of *Integricardium* occurs in North America, *Integricardium holmesi* (Russell, 1943), from the Maastrichtian Eastend Formation of Saskatchewan, but the genus is otherwise known only from Hettangian to Maastrichtian-age rocks in Africa and Eurasia (Keen, 1969; Marincovich, 1993; Schneider, 1995). Although the generic assignment of *Protocardia*? sp. indet. by Marincovich (1993) is uncertain, *Protocardia* is known from all continents except Australia and Antarctica, and has a stratigraphic range of Rhaetian to Maastrichtian (Keen, 1969; Schneider, 1995).

Onestia and *Integricardium* are two of six genus-level bivalve taxa in the Ocean Point beds that otherwise have their youngest occurrences in Mesozoic faunas (Marincovich, 1993). *Camptochlamys* Arkell, 1930, is otherwise known only from the Late Jurassic. The next youngest occurrence of *Tancredia* (*Tancredia*) Lycette, 1850, is Albian. The next youngest occurrences of *Oxytoma* (*Hypoxytoma*) Ichikawa, 1958, and *Tellinimera* Conrad, 1860, are Maastrichtian. These six of the 24 genera reported from the Ocean Point beds are considered to be relict taxa. These six genera were diverse and widely distributed during the Mesozoic, but by the Late Paleocene they were represented by a single species living only in the Arctic Ocean (Marincovich, 1993, 1996). However, *Onestia* is the only one of these six taxa to be represented by a species known from the Cretaceous (Marincovich, 1993). Although detailed systematic analyses of these relict bivalve taxa remain to be done, the Paleocene species of these taxa do not appear to be as evolutionarily conservative as *Onestia onestae.*

The presence of *Onestia onestae* in Upper Paleocene strata of northern Alaska reinforces the concept that relict Mesozoic mollusks lived into Cenozoic time within a geographically isolated Arctic Ocean (Marincovich, 1993, 1996). The occurrence of *O. onestae* in northern Alaska





Explanation of Figures 6 and 7

Figure 6. *Onestia onestae,* detail of hinge of right valve, UCMP 154061. Figure 7. *Onestia onestae,* interior view of right valve showing adductor muscles and pallial line, UCMP 154063.

supports the idea that a significant portion of Paleocene mollusks in the Arctic realm descended from Western Interior Seaway Cretaceous faunas. This find extends the geographic range of *Onestia* into high northern latitudes where it was previously unknown.

Acknowledgments. Type material of *Onestia onestae* was provided by T. E. Bolton of the Geological Survey of Canada, and comparative specimens of *Integricardium holmesi* were provided by J. Waddington of the Royal Ontario Museum.

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